decided red colour, the rest being white, as usual. Taking up some that fell in the gig, Mr. Mullan found that the colour was not merely superficial, but pervaded the substance of the hail-stone, and, on melting, they stained the fingers. He did not think, or had not the means, of preserving any of the water resulting. Has the like been observed before?

Spectral Images

MR. BIDWELL'S notice of spectral images (NATURE, vol. xxxii. p. 30) calls to mind certain phenomena I witnessed while riding in a railway train in Kentucky last October. The fence of the railway consisted of posts of about 6 inches in diameter, and twenty paces apart, connected by wires. The posts had newly been painted green. I was seated on the right side of the carriage, face forwards; the speed fully twenty miles an hour, with the sun behind my right shoulder, when looking at the posts on the left side, brightly illuminated by the sun, I observed that each post had the appearance of a twin post immediately in advance of it—touching it—of a red colour. To make myself sure that I was not deceived by some abnormal affection, I called the attention of a niece of mine to the phenomenon, and she saw it quite as well as I did. Another niece, however, failed to make it out. I am under the belief that the red post was the complementary colour of the green one, appearing the instant after the latter had been seen, and though apparently in advance in space of the green post, really was seen later in time. The fact of both being apparently seen simultaneously, is accounted for by the well-known law of retinal images lingering on vision. HENRY MUIRHEAD

Cambuslang

THE NEW OUTBURST OF LAVA FROM VESUVIUS

YESTERDAY, May 2, up to two o'clock, Vesuvius appeared to be in its natural state of activity, such as persisted with slight variations for some considerable time. At that hour the lava, which was at some height within the cone of eruption, forced a way out at its base, traversing the plain of old lava filling the crater of 1872, and producing a rent about one quarter the way down the great Vesuvian cone. This rent represents the extension outwards of a volcanic dyke that has been in process of formation for over two years. A visitor during that period who walked around the southern rim of the 1872 crater, might have noticed a fissure varying from a few inches up to 2 feet wide, and extending inwards across the crater plain, until lost beneath the *ejectamenta* of the cone of eruption. From this fissure issued a powerful current of hot air, and in part of its course an abundance of HCl. This latter was indicated by the continual decomposition of the scoria and ash in its immediate neighbourhood, so that a large patch of yellow dust filled with the unattached pyroxene crystals was a point of bright colour in the black scoria-covered lava-plain. The lava at first actually issued, or, more properly, welled up from this fissure, but its point of exit was soon lowered by the cutting down of the outer slope. The lava soon commenced to flow down the cone with considerable rapidity, forming two distinct parallel streams averaging fifty metres apart, so that in the evening the landscape was lit up by these two brilliant streaks of fire. This morning I started early, and ascended on foot to the eastern side of the two streams, though often inconvenienced by the hot wind and exhalations blown off the lava. The streams take origin close together, and no doubt conjoin, but are covered by scoria—a vast quantity of *lapillo* and ash that has been slipped downwards and forward, forming a rough annular space which would require a drawing to explain. At the upper end of this we have part of the great cone slipped down, showing in section the dyke, which I may call hollow; we have a fissure which was filled by lava, and which consolidated and adhered to its sides, forming *salbam;* but before the central part solidified, the general level was lowered, and it drained away, leaving the dyke divided in two by an empty space. At 2 p.m. to-day the streams of lava had the following dimensions at their exit:—

	Eastern		Western
Breadth about	1½ metres	...	About 2½ metres
Depth estimated at	1 metre	...	at 2 metres

Rate of flow on both, about 1 metre per second.

The output therefore equals for the eastern stream about 90 cubic metres per hour, or 2160 cubic metres in 24 hours, whilst that of the western stream represents 300 cubic metres per hour, or 7200 in 24 hours. The two streams, therefore, represent an output of 9360 cubic metres during the 24 hours, from May 2 to 3, at 2 p.m. This quantity would equal a deposit of rock of about 1 km. long, 9 m. broad, and 1 m. thick, which is rather an under-estimation of what now lies on the side of the mountain, for the two streams had at the hour of observation traversed more than two-thirds of the *pedimenture*. The amount of lava represents far more than what occupied the chimney above the level of the lateral opening, and the mechanism of the increased quantity extruded I have gone into fully in a paper read last week before the Geological Society. The cone of eruption only now gives forth vapour, its stone-throwing propensities being stopped by the lowering of the magma level. In consequence of the want of support of its inner walls by disappearance of the fluid column, these are rapidly crumbling in, and the craterial inner cavity much increased in size. In the same way a breach has been made in the line of the dyke by falling in of that part of loose materials immediately above it.

This change in Vesuvius will no doubt be put down in history as an eruption, and possibly a relationship sought between contemporaneous earthquakes, or some other phenomena. It is nothing more nor less than the final giving way of part of the cone before a dyke that has been working its way out for years.

I send you these few notes after a long day's climb, exposed to great changes of temperature and mephitic vapours. I ask, therefore, that this will be taken as an excuse for these rough and ready notes, which I thought your readers would be interested to have quickly.

Naples, May 3 H. J. JOHNSTON-LAVIS

EXPERIMENTS WITH COAL-DUST AT NEUNKIRCHEN, IN GERMANY

IN a former article on this subject which appeared in NATURE of Nov. 6 last (p. 12), I described the apparatus employed by the Prussian Firedamp Commission in making their experiments, and at the same time I gave an account of four experiments that were seen by Mr. Wm. Thomas Lewis and myself.

No official account of these experiments had been published at that time, but quite recently Herr Hilt and Herr Margraf have made a joint report in the name of the Commission. As this report is intended to be only a preliminary one, it does not give the whole of the details of each experiment, but it shows as far as it goes that everything has been conceived and carried out in a spirit of liberality and thoroughness.

At the outset Herr Hilt states that the uncertainty which seemed to surround this important question, and in particular the peculiar views that had been enunciated by MM. Mallard and Le Chatelier, who reported upon it to the French Commission du Grisou,[1] had induced him to address a letter on the subject, dated December 15, 1883, to the Prussian Wetter-Commission, urging them as a matter of duty to take it up and investigate it by a series of large-scale experiments. The French Commissioners, referred to, stated at the end of their report that "they considered it established that coal-dust in the absence of fire-damp does not constitute an element of

[1] *Annales des Mines*, Janvier—Février, 1882.

danger." "It may, however, play an important part in aggravating the consequences of a firedamp explosion." I had myself keenly felt how difficult it would be after a verdict of this kind, emanating from such high authorities, to make further progress in the work of convincing practical mining men of the truth of the views I had previously advocated in the pages of the Royal Society's *Proceedings*. For that reason, and in the absence of some powerful weapon wherewith to meet the French Commissioners with some chance of success, I have hitherto desisted from doing battle with them, although I have been satisfied they were in error from the first. The required weapon has been provided by Herr Hilt, the spokesman of the Prussian Commission, and may now, I think, be made use of without much fear of future contradiction.

Speaking of coal-dust from Pluto Mine, in Westphalia, Herr Hilt says, as the outcome of a long series of practical experiments on the largest scale yet attempted: "Es kann keinem Zweifel unterliegen dass mann mit dieser Staubsorte bei Verlängerung der Strecke und Streuung auch der Flamme eine beliebige Länge würdegebenkönnen. Ganz ähnlich erhält sich der Staub von Neu Iserlohn." Or: "There can be no doubt that with this kind of dust the flame could be lengthened out to any desired extent, provided the gallery and the layer of dust on its floor were made equally long." "The dust of Neu Iserlohn behaves in exactly the same way."[1]

After carefully examining the details of this report, I think it not improbable that many, if not most, of the other twenty-four kinds of coal-dust that were subjected to experiment would have given results similar to those which led to the foregoing remarks had they been employed in the same state of minute subdivision. Differences in chemical composition do not appear to have as much effect in controlling the length of flame produced by a given dust under a certain set of conditions as the comparative fineness of the particles of which it is composed. In order to show the effect of fineness Herr Margraf has divided the dusts into five classes, as follows:—

Number of Dusts in each Class.	Designation of Class.	Length of Flame produced by firing 230 grm. of powder in cannon next floor, the floor being strewn with coal-dust for a length of 10 m.
Five, beginning with Pluto	Very fine ...	21 to 31 m.
Twelve, ending with Camphausen	Fine	13 to 21 m.
Four	Medium ...	12 to 15 m.
Five	Coarse	6 to 12 m.

Some experiments were also made with dust passed through sieves having meshes of various widths, which showed that the finer the state of subdivision, the longer was the corresponding flame.

From this it is obvious that before anything definite can be ascertained regarding the influence of chemical composition, it will be necessary to reduce the dusts to a uniform standard of fineness. Herr Margraf proposes to do this by passing them through a sieve with meshes 1 mm. wide. I am afraid, however, that some more exact method of effecting a separation of the very fine from the moderately fine particles will have to be resorted to before a satisfactory result can be looked for. A current of air ascending slowly at a uniform rate would be a better means than any conceivable kind of sieve.

I have on several previous occasions pointed out that when a colliery explosion has been begun in a dry mine the coarser particles of coal-dust are winnowed from the finer ones by the blast of air which sweeps through the workings in advance of the flame. It seems to me that under these circumstances experiments made with any other than the finest particles of each kind of dust can serve no practicable purpose whatever, and that any general conclusions drawn from them must necessarily be misleading. It is further highly probable that this is the rock upon which the French Commission was shipwrecked.

They had ascertained by actual experiment that, as the coarser particles of any given dust were removed by sifting, the flame produced under the same set of conditions became longer and larger in proportion to the fineness of the remaining dust. Yet they failed to carry the argument to its legitimate conclusion. They appear to have been misled either by too much speculation, or by the negative results of their experiments, due, it may be, to the smallness of the scale upon which they were made. They finally pronounced coal-dust to be an element of very secondary importance in colliery explosions, thereby allowing a splendid opportunity to slip from their grasp. The Prussian Commissioners were not slow to take advantage of the opening thus afforded them. Thanks partly to the large scale upon which they have set to work, partly to the natural fineness of Pluto and Neu Iserlohn dust, they have been fortunate in obtaining a series of positive results which amply confirm those previously obtained with the somewhat smaller apparatus belonging to the Lords of Committee of Council on Education set up in this country under the auspices of the Royal Society (No. IV. paper, "On the Influence of Coal-dust in Colliery Explosions," *Proc. Roy. Soc.*, 1881).

The dust brought from Camphausen Colliery does not appear to stand very high on Herr Margraf's list, and yet, since the publication of the memoir, that colliery has been devastated by one of the most violent explosions on record, in which it is admitted, I believe, that coal-dust, and not fire-damp, was the principal agent of destruction. Are we to conclude from this that the nine dusts which lie between Pluto and Camphausen in the order of relative danger are equally liable to produce a flame of indefinite length under like favourable conditions? and, if so, is it not obvious that the experiments are not as reliable as might be wished, since they fail to tell us so?

Before concluding, I might mention that Herr Hilt refers to and agrees with a remark made by MM. Mallard and Le Chatelier to the effect that the method of experiment followed by Sir Frederick Abel and myself when using the apparatus described in my first paper was "too little exact" to determine accurately what percentage of gas is required to render a mixture of coal-dust and air inflammable. My earliest experiments here referred to were made with the view of finding, if possible, some rational explanation of great colliery explosions which up to that time appear to have baffled every attempt to grapple with them, and were not intended to form a kind of counterpart on the large scale of the exact eudiometric processes resorted to in the laboratory. At the same time I may state, however, that, so far as I have been able to ascertain by reading and observation, the methods then employed will compare not unfavourably, as regards exactness, with any that have succeeded them, not excluding those of the Prussian Wetter-Commission.

W. GALLOWAY

[1] It may be instructive to compare this conclusion with the second sentence of No. 1 paper, "On the Influence of Coal-dust in Colliery Explosions," *Proc. Roy. Soc.*, 1876; the second last sentence of No. 2 paper, *ibid.*, 1879; the conclusion of No. 3 paper, *ibid.*, 1881.—(Abstract).

THE FAUNA OF RUSSIAN CENTRAL ASIA

UNTIL within the last thirty years Turkistan has been unknown to science, and what is now ascertained concerning its fauna and flora is for the most part inaccessible to the scientific world because written in Russian. Not that autoptic writers of eminence upon the zoology of the country are numerous. They do not number a dozen, the names most conspicuous being Prjevalsky, Alpheraky, Bogdanoff, Severtsoff, and especially Fedchenko. Prjevalsky's routes do not touch mine, except in the Kuldja